In this technological age, mathematics is more important than ever. When students leave school, they are more and more likely to use mathematics in their work and everyday lives — operating computer equipment, planning timelines and schedules, reading and interpreting data, comparing prices, managing personal finances, and completing other problem-solving tasks. What they learn in mathematics and how they learn it will provide an excellent preparation for a challenging and ever-changing future.

The state of Indiana has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding, and skills students should acquire in Grade 5:

Standard 1 — Number Sense

Understanding the number system is the basis of mathematics. Students extend their understanding of the magnitudes of numbers to rounding whole numbers and decimals to any place value. They order and compare whole numbers and decimals using the correct symbols for greater than and less than. They develop the concept of percentage as parts of a hundred and compare different ways of looking at fractions. They identify whole numbers as prime or composite, and they compare fractions, decimals, and mixed numbers on a number line.

Standard 2 — Computation

Fluency in computation is essential. Students extend the standard methods for multiplying and dividing to larger numbers. They add and subtract more complex fractions and decimals, learning how these different representations of numbers can be manipulated. They also develop an understanding of how to multiply and divide fractions.

Standard 3 — Algebra and Functions

Algebra is a language of patterns, rules, and symbols. Students at this level develop further the fundamental concept of a variable — having a letter stand for all numbers of a certain kind. They use this to write simple algebraic expressions and to evaluate them. They begin to develop the idea of linking an algebraic equation to a graph, by finding ordered pairs that fit a linear equation, plotting these as points on a grid, and drawing the resulting straight line. They also interpret graphs to answer questions.

Standard 4 — Geometry

Students learn about geometric shapes and develop a sense of space. They draw angles, parallel and perpendicular lines, the radius and diameter of circles, and other geometric shapes, using ruler, compass, protractor, and computer drawing programs. They identify congruent triangles and explain their reasoning using specific geometrical terms, such as equilateral, isosceles, acute, and obtuse. They classify polygons with five or more sides. They develop an understanding of reflectional and rotational symmetry, and they construct prisms and pyramids, developing their ability to work in three dimensions.

Standard 5 — Measurement

The study of measurement is essential because of its uses in many aspects of everyday life. Students develop and use the formulas for calculating perimeters and areas of triangles, parallelograms, and trapezoids. They extend these ideas to finding the volume and surface area of rectangular solids. They understand and use additional units for measuring weight: ounce, gram, and ton. They also add and subtract with money in decimal notation.

Standard 6 — Data Analysis and Probability

Data are all around us — in newspapers and magazines, in television news and commercials, in quality control for manufacturing — and students need to learn how to understand data. At this level, they use the mean, median, mode, and range to describe data sets. They further develop the concept of probability, recording probabilities as fractions between 0 and 1 and linking these to levels of certainty about the events described.

Standard 7 — Problem Solving

In a general sense, mathematics is problem solving. In all of their mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. As they develop their skills with algebra, geometry, or measurement, for example, students move from simple to more complex ideas by taking logical steps that build a better understanding of mathematics.

As part of their instruction and assessment, students should also develop the following learning skills by Grade 12 that are woven throughout the mathematics standards:

Communication

The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.

Reasoning and Proof

Mathematics is developed by using known ideas and concepts to develop others. Repeated addition becomes multiplication. Multiplication of numbers less than ten can be extended to numbers less than one hundred and then to the entire number system. Knowing how to find the area of a right triangle extends to all right triangles. Extending patterns, finding even numbers, developing formulas, and proving the Pythagorean Theorem are all examples of mathematical reasoning. Students should learn to observe, generalize, make assumptions from known information, and test their assumptions.

Representation

The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, $\frac{1}{4}$, one divided by four, 0.25, $\frac{1}{8} + \frac{1}{8}$, 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π, unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.

Connections

Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science, geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.

Standard 1

Number Sense

Students compute with whole numbers, decimals, and fractions and understand the relationship among decimals, fractions, and percents. They understand the relative magnitudes of numbers. They understand prime* and composite* numbers.*

5.1.1 Convert between numbers in words and numbers in figures, for numbers up to millions and decimals to thousandths.

Example: Write the number 198.536 in words.

5.1.2 Round whole numbers and decimals to any place value.

Example: Is 7,683,559 closer to 7,600,000 or 7,700,000? Explain your answer.

5.1.3 Arrange in numerical order and compare whole numbers or decimals to two decimal places by using the symbols for less than (<), equals (=), and greater than (>).

Example: Write from smallest to largest: 0.5, 0.26, 0.08.

5.1.4 Interpret percents as a part of a hundred. Find decimal and percent equivalents for common fractions and explain why they represent the same value.

Example: Shade a 100-square grid to show 30%. What fraction is this?

5.1.5 Explain different interpretations of fractions: as parts of a whole, parts of a set, and division of whole numbers by whole numbers.

Example: What fraction of a pizza will each person get when 3 pizzas are divided equally among 5 people?

5.1.6 Describe and identify prime and composite numbers.

Example: Which of the following numbers are prime: 3, 7, 12, 17, 18? Justify your choices.

5.1.7 Identify on a number line the relative position of simple positive fractions, positive mixed numbers, and positive decimals.

Example: Find the positions on a number line of $1\frac{1}{4}$ and 1.4.

* whole number: 0, 1, 2, 3, etc.

* prime number: a number that can be evenly divided only by 1 and itself (e.g., 2, 3, 5, 7, 11)

* composite number: a number that is not a prime number (e.g., 4, 6, 8, 9, 10)

Standard 2

Computation

Students solve problems involving multiplication and division of whole numbers and solve problems involving addition, subtraction, and simple multiplication and division of fractions and decimals.

5.2.1 Solve problems involving multiplication and division of any whole numbers.

Example: 2,867 × 34 = ?. Explain your method.

5.2.2 Add and subtract fractions (including mixed numbers) with different denominators.

Example: $3\frac{4}{5} - 2\frac{2}{3} = ?$.

5.2.3 Use models to show an understanding of multiplication and division of fractions.

Example: Draw a rectangle 5 squares wide and 3 squares high. Shade $\frac{4}{5}$ of the rectangle, starting from the left. Shade $\frac{2}{3}$ of the rectangle, starting from the top. Look at the fraction of the squares that you have double-shaded and use that to show how to multiply $\frac{4}{5}$ by $\frac{2}{3}$.

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5.2.4 Multiply and divide fractions to solve problems.

Example: You have $3\frac{1}{2}$ pizzas left over from a party. How many people can have $\frac{1}{4}$ of a pizza each?

5.2.5 Add and subtract decimals and verify the reasonableness of the results.

Example: Compute 39.46 − 20.89 and check the answer by estimating.

5.2.6 Use estimation to decide whether answers are reasonable in addition, subtraction, multiplication, and division problems.

Example: Your friend says that 2,867 × 34 = 20,069. Without solving, explain why you think the answer is wrong.

5.2.7 Use mental arithmetic to add or subtract simple decimals.

Example: Add 0.006 to 0.027 without using pencil and paper.

Standard 3

Algebra and Functions

Students use variables in simple expressions, compute the value of an expression for specific values of the variable, and plot and interpret the results. They use two-dimensional coordinate grids to represent points and graph lines.

5.3.1 Use a variable to represent an unknown number.

Example: When a certain number is multiplied by 3 and then 5 is added, the result is 29. Let x stand for the unknown number and write an equation for the relationship.

5.3.2 Write simple algebraic expressions in one or two variables and evaluate them by substitution.

Example: Find the value of $5x + 2$ when $x = 3$.

5.3.3 Use the distributive property* in numerical equations and expressions.

Example: Explain how you know that $3(16 - 11) = 3 \times 16 - 3 \times 11$.

5.3.4 Identify and graph ordered pairs of positive numbers.

Example: Plot the points (3, 1), (6, 2), and (9, 3). What do you notice?

5.3.5 Find ordered pairs (positive numbers only) that fit a linear equation, graph the ordered pairs, and draw the line they determine.

Example: For $x = 1, 2, 3$, and 4, find points that fit the equation $y = 2x + 1$. Plot those points on graph paper and join them with a straight line.

5.3.6 Understand that the length of a horizontal line segment on a coordinate plane equals the difference between the x-coordinates and that the length of a vertical line segment on a coordinate plane equals the difference between the y-coordinates.

Example: Find the distance between the points (2, 5) and (7, 5) and the distance between the points (2, 1) and (2, 5).

5.3.7 Use information taken from a graph or equation to answer questions about a problem situation.

Example: The speed (v feet per second) of a car t seconds after it starts is given by the formula $v = 12t$. Find the car's speed after 5 seconds.

* distributive property: e.g., $3(5 + 2) = (3 \times 5) + (3 \times 2)$

Standard 4

Geometry

Students identify, describe, and classify the properties of plane and solid geometric shapes and the relationships between them.

5.4.1 Measure, identify, and draw angles, perpendicular and parallel lines, rectangles, triangles, and circles by using appropriate tools (e.g., ruler, compass, protractor, appropriate technology, media tools).

Example: Draw a rectangle with sides 5 inches and 3 inches.

5.4.2 Identify, describe, draw, and classify triangles as equilateral*, isosceles*, scalene*, right*, acute*, obtuse*, and equiangular*.

Example: Draw an isosceles right triangle.

5.4.3 Identify congruent* triangles and justify your decisions by referring to sides and angles.

Example: In a collection of triangles, pick out those that are the same shape and size and explain your decisions.

5.4.4 Identify, describe, draw, and classify polygons*, such as pentagons and hexagons.

Example: In a collection of polygons, pick out those with the same number of sides.

5.4.5 Identify and draw the radius and diameter of a circle and understand the relationship between the radius and diameter.

Example: On a circle, draw a radius and a diameter and describe the differences and similarities between the two.

5.4.6 Identify shapes that have reflectional and rotational symmetry*.

Example: What kinds of symmetries have the letters M, N, and O?

5.4.7 Understand that 90°, 180°, 270°, and 360° are associated with quarter, half, three-quarters, and full turns, respectively.

Example: Face the front of the room. Turn through four right angles. Which way are you now facing?

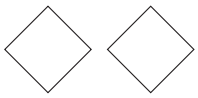
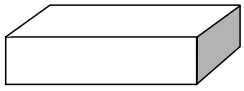
5.4.8 Construct prisms* and pyramids using appropriate materials.

Example: Make a square-based pyramid from construction paper.

5.4.9 Given a picture of a three-dimensional object, build the object with blocks.

Example: Given a picture of a house made of cubes and rectangular prisms, build the house.

* equilateral triangle: a triangle where all sides are congruent
* isosceles triangle: a triangle where at least two sides are congruent
* scalene triangle: a triangle where no sides are equal
* right triangle: a triangle where one angle measures 90 degrees
* acute triangle: a triangle where all angles are less than 90 degrees
* obtuse triangle: a triangle where one angle is more than 90 degrees
* equiangular triangle: a triangle where all angles are of equal measure

* congruent: the term to describe two figures that are the same shape and size 
* polygon: a two-dimensional shape with straight sides (e.g., triangle, rectangle, pentagon)
* reflectional and rotational symmetry: letter M has reflectional symmetry in a line down the middle; letter N has rotational symmetry around its center
* prism: a solid shape with fixed cross-section (a right prism is a solid shape with two parallel faces that are congruent polygons and other faces that are rectangles) 

Standard 5

Measurement

Students understand and compute the areas and volumes of simple objects, as well as measuring weight, temperature, time, and money.

5.5.1 Understand and apply the formulas for the area of a triangle, parallelogram, and trapezoid.

Example: Find the area of a triangle with base 4 m and height 5 m.

5.5.2 Solve problems involving perimeters and areas of rectangles, triangles, parallelograms, and trapezoids, using appropriate units.

Example: A trapezoidal garden bed has parallel sides of lengths 14 m and 11 m and its width is 6 m. Find its area and the length of fencing needed to enclose it. Be sure to use correct units.

5.5.3 Use formulas for the areas of rectangles and triangles to find the area of complex shapes by dividing them into basic shapes.

Example: A square room of length 17 feet has a tiled fireplace area that is 6 feet long and 4 feet wide. You want to carpet the floor of the room, except the fireplace area. Find the area to be carpeted.

5.5.4 Find the surface area and volume of rectangular solids using appropriate units.

Example: Find the volume of a shoe box with length 30 cm, width 15 cm, and height 10 cm.

5.5.5 Understand and use the smaller and larger units for measuring weight (ounce, gram, and ton) and their relationship to pounds and kilograms.

Example: How many ounces are in a pound?

5.5.6 Compare temperatures in Celsius and Fahrenheit, knowing that the freezing point of water is 0°C and 32°F and that the boiling point is 100°C and 212°F.

Example: What is the Fahrenheit equivalent of 50°C? Explain your answer.

5.5.7 Add and subtract with money in decimal notation.

Example: You buy articles that cost $3.45, $6.99, and $7.95. How much change will you receive from $20?

Standard 6

Data Analysis and Probability

Students collect, display, analyze, compare, and interpret data sets. They use the results of probability experiments to predict future events.

5.6.1 Explain which types of displays are appropriate for various sets of data.

Example: Conduct a survey to find the favorite movies of the students in your class. Decide whether to use a bar, line, or picture graph to display the data. Explain your decision.

5.6.2 Find the mean*, median*, mode*, and range* of a set of data and describe what each does and does not tell about the data set.

Example: Find the mean, median, and mode of a set of test results and describe how well each represents the data.

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5.6.3 Understand that probability can take any value between 0 and 1, events that are not going to occur have probability 0, events certain to occur have probability 1, and more likely events have a higher probability than less likely events.

Example: What is the probability of rolling a 7 with a number cube?

5.6.4 Express outcomes of experimental probability situations verbally and numerically (e.g., 3 out of 4, $\frac{3}{4}$).

Example: What is the probability of rolling an odd number with a number cube?

* mean: the average obtained by adding the values and dividing by the number of values
* median: the value that divides a set of data, written in order of size, into two equal parts
* mode: the most common value in a given data set
* range: the difference between the largest and smallest values

Standard 7

Problem Solving

Students make decisions about how to approach problems and communicate their ideas.

5.7.1 Analyze problems by identifying relationships, telling relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

Example: Solve the problem: "When you flip a coin 3 times, you can get 3 heads, 3 tails, 2 heads and 1 tail, or 1 head and 2 tails. Find the probability of each of these combinations." Notice that the case of 3 heads and the case of 3 tails are similar. Notice that the case of 2 heads and 1 tail and the case of 1 head and 2 tails are similar.

5.7.2 Decide when and how to break a problem into simpler parts.

Example: In the first example, decide to look at the case of 3 heads and the case of 2 heads and 1 tail.

Students use strategies, skills, and concepts in finding and communicating solutions to problems.

5.7.3 Apply strategies and results from simpler problems to solve more complex problems.

Example: In the first example, begin with the situation where you flip the coin twice.

5.7.4 Express solutions clearly and logically by using the appropriate mathematical terms and notation. Support solutions with evidence in both verbal and symbolic work.

Example: In the first example, make a table or tree diagram to show another student what is happening.

5.7.5 Recognize the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

Example: You are buying a piece of plastic to cover the floor of your bedroom before you paint the room. How accurate should you be: to the nearest inch, foot, or yard? Explain your answer.

5.7.6 Know and apply appropriate methods for estimating results of rational-number computations.

Example: Will 7×18 be smaller or larger than 100? Explain your answer.

5.7.7 Make precise calculations and check the validity of the results in the context of the problem.

Example: A recipe calls for $\frac{3}{8}$ of a cup of sugar. You plan to double the recipe for a party and you have only one cup of sugar in the house. Decide whether you have enough sugar and explain how you know.

Students determine when a solution is complete and reasonable and move beyond a particular problem by generalizing to other situations.

5.7.8 Decide whether a solution is reasonable in the context of the original situation.

Example: In the first example about flipping a coin, check that your probabilities add to 1.

5.7.9 Note the method of finding the solution and show a conceptual understanding of the method by solving similar problems.

Example: Find the probability of each of the combinations when you flip a coin 4 times.

NOTES